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ABSTRACT

Energy conservation measures that can be effected in the architecture and engineering of new and existing school buildings are listed. Guidelines are also offered for general school operation and maintenance. (MLF)

ENERGY CONSERVATION GUIDELINES FOR PENNSYLVANIA SCHOOLS

Pennsylvania Department of Education 1976

ENERGY CONSERVATION GUIDELINES

FOR

PENNSYLVANIA SCHOOLS

Introduction

Designing tomorrow's schools is one of the greatest energy conservation challenges facing education today. A well designed, conservation oriented building and heating system can effect substantial savings.

Many school buildings in Pennsylvania lose excessive amounts of energy that are costly to school districts and to the economy. School buildings over thirty years old may have little or no insulation above ceilings or in the walls. They may have excessive window areas and other places where heat loss is heavy in winter and heat gain heavy in summer. Mechanical system inadequacies may create heating and temperature control problems that result in inefficient operation, waste of precious fuel, and discomfort for occupants. These buildings should be analyzed by school district architects and engineers to determine the most practical steps to correct problems.

Energy conservation should be considered in all phases of school building design: new construction, changes in existing structures, operation and maintenance of existing buildings.

The following are areas and items for consideration:

NEW SCHOOL BUILDINGS

Architecture

1. Reduce exterior wall and roof areas with simplified, more compact plans. Avoid soffitted areas under interior spaces to prevent unnecessary heat loss.

2. Orient large areas of glass to north or south to avoid the sun's direct rays.

3. At entrances where major traffic flow is anticipated, create air locks in the form of vestibules at least eight to 12 feet deep.

4. The location and number of windows in a school should show a reasonable balance of five important factors:

   - Opportunity to see outside
   - Source of natural light
   - Capability for adequate natural ventilation
   - Considerations for the use of the space as a proper environment for learning
   - The conservation of energy through conservative use of window area and use of better quality windows with good insulation characteristics and low transmission glass.

5. Insulate walls (U=0.12), ceilings and roofs (U=0.06) to the transmission coefficients 'U' indicated, where there is potential heat loss. Careful inspection of the application of insulation should insure a measure of fuel conservation. Properly ventilated spaces above the insulation are still necessary to prolong the life of building materials.

Engineering

1. A feasibility study of the availability and comparative cost of various fuels.

2. The efficiency of various types of heating systems.

3. Various types of heat recovery systems such as heat wheel, heat pump, heat from lights.

4. Increased use of thermal insulation for heating and ventilating systems and hot water piping.

5. Specifying construction materials that provide the following 'U' values as maximums:

Roof and ceiling combination	0.06
Walls	0.12

6. Designing boilers for capacity or near-capacity operation to achieve maximum boiler efficiency.

7. Designing control systems with enough zones to provide for flexible operation of heating and ventilating system.

8. Separate water heater for swimming pools.

9. Providing electric ignition for gas-fired boilers rather than gas pilots.

10. Designing lighting system for 50 f.c. for instructional areas emphasizing quality of lighting.

11. For electric heat, a heat pump is more efficient than resistance heating. Large, water cooled units are more efficient than the air-to-air type.

12. Use of higher voltage for electrical distribution.

13. Avoiding large high pressure, high horsepower central fan systems. Pump chilled and hot water to smaller, low pressure air handlers.

14. Designing domestic hot water systems for maximum 110-120 degrees Fahrenheit.

EXISTING SCHOOL BUILDINGS

Architecture

1. Insulate above the ceiling, at the roof where possible, to achieve an approximate 'U'value of 0.06.

2. Insulate exterior walls to develop a 'U' value of 0.12 where practical.

3. Replacement of poorly fitting and deteriorating windows with new windows of good quality and, if possible, insulating glass. Operation of the windows should provide protection by deflecting fresh air from blowing directly onto occupants.

4. Storm windows to reduce heat loss.

5. On major renovation projects, reduction in the number of windows in exterior walls.

6. Check of building for openings between construction elements that may have developed over the years: the roof, air intakes, windows, basement areaways, etc. Seal or repair the openings appropriately.

Engineering

1. Where possible, additional insulation in areas of high heat loss.

2. Investigating the feasibility of providing heat recovery equipment for incinerators, hot water heaters, space heating, refrigeration units, lighting fixtures and hot water discharge from kitchens, launderies, etc.

3. Use of solar energy (shades, drapes).

4. Incorporate domestic hot water circulating pumps in control system.

5. Lowering lighting level to about 50 f.c. in instructional spaces other than shops and hazardous areas, and:

    . Install fluorescents where incandescents now exist.
    . Use reduced wattage higher efficiency bulbs and tubes.
    . Use lighter finishes on ceilings, walls and floors for maximum reflectance.

GENERAL OPERATION AND MAINTENANCE

1. Prepare a comprehensive program of periodic maintenance.

2. Lower space heating temperature settings, both for occupied and unoccupied cycles.

3. Lower temperature for domestic hot water to 110 degrees F maximum except kitchen wash-rinse which must remain at 180 degrees F.

4. Modify lighting practices:

   - Install fluroescent tubes where incandescents now exist in offices, meeting rooms, etc.
   - Turn off lights when not in use.
   - Clean and/or replace lamps regularly.
   - Relight with reduced wattage higher efficiency bulbs and fluorescent tubes.
   - Utilize daylight as much as possible.
   - Use lighter finishes on ceilings, walls and floors for maximum reflectance.

5. Keep air filters clean at all times.

6. Do not block supply or return air grilles with furniture, books, etc.

7 Inspect and repair insulation and caulking for walls, ceilings and windows.

8. Inspect and repair insulation on all heating and cooling piping, fittings, duct work, etc.

9. Keep all heating and cooling equipment in good condition; also fans, pumps, compressors and other rotating equipment in good condition.

10. Keep all parts of automatic control system properly adjusted. This usually requires trained outside labor.

11. Repair all leaking faucets, particularly hot water.

12. Operate heating boilers at the most efficient level consistent with the required heating load; use other boilers in stand-by status at absolute minimum.

13. Provide manual switches for exhaust fans in science and homemaking laboratories, shops, kitchen, etc., so that fans may be operated only as needed.

14. Reduce fresh air intake where possible, keeping the following criteria in mind:

    .Reduction will be undertaken only with the guidance and assistance of your architect or engineer.
    .Reduction will be experimental permitting subsequent adjustment without creating odor or temperature problems.
    .Common sense and good judgment will be employed to prevent extreme measures being taken.

15. When initiating conservation programs of any nature prepare and maintain a record of initial existing conditions, pertinent technical data, progress reports, and any conclusions and recommendations which may apply.

Energy Conservation Activities Quiz

Question: What school administrator planned coordinated office activities over the recent Christmas - New Year break, which brought the office staffs of the entire district into one location, permitted completion of a large and important project, allowed all of the buildings in the district to maintain minimum energy use levels - except that in which the activities were centered?

Answer: We are not certain that any school administrator did just that. We are certain that much excellent - and some ingenious - energy conservation planning remains localized.

If you know of any such planning which is worthy of broad recognition and replication, please send a description to the attention of Energy Conservation Coordinator, Pennsylvania Department of Education, Box 911, Harrisburg, Pennsylvania 17126. We will arrange for its being widely disseminated.